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Analysis of changes in Land Use and Land Cover based on Remote Sensing and GIS technology: The case of Kakching District, Manipur, India.

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ABSTRACT:

The issues and problems related to the environment that humanity are facing today can be contributed to the changes brought down to the landscapes around the world. The various human activities and process of rapid urbanisation has altered the landscape of an area or a region. It means that human beings have become the dominant agent for changing the landscape. The ever-increasing population leading to subsequent demand for natural resources has resulted into transformation of land features and it adversely affects the existing environment leading to a factor of climate change. Remote sensing and Geographic Information System (GIS) is an essential and fundamental tool which have been used to study the dynamics of land use and land cover of a region or an area of interest (AOI). The changes in Land Use Land Cover (LULC) is directly linked to the sustainability of the ecosystem. The present study aims to analyse the land use changes and patterns of Kakching District in Manipur, India. Using the multi-temporal satellite images of IRS LISS-III and LISS-IV having spatial resolution of 23.5 m and 5.8 m respectively and with the using ARC GIS-10.4, ERDAS IMAGINE-2015 and Google-Earth Pro software, the changing patterns in increment and reduction of the areas of Kakching District are classified and analysed. The finding shows some significant changes in the land use pattern and its climate change phenomena.

Keywords: Landscape, GIS, LULC, Spatial resolution, Kakching.

Introduction:

The land resource is one of the most important natural resources that embodies soil, water and different species of plants and animals that makes the ecosystem. The land resource plays an important role in the process of development or both nation and region. Availability of accurate and timely update of land use/ land cover classification have a great significance in providing critical major inputs to decision making to global change, environment monitoring, management and planning in the future. The growing population and increasing socio-economic necessities creates a pressure on land use/land cover. This pressure results in unplanned and uncontrolled changes in land Use Land cover (LULC) (Seto, K.C. *et.al.*,2002). Monitoring the land use/land cover (LULC) with the help of remote sensing imagery has the advantages of macroscopic, fast, real-time and other characteristics over a large area. Both natural and anthropogenic factors are responsible for driving land use/cover change whereby various natural ecosystem processes are disturbed thereby affecting human beings

the most (Turner and Ruscher 1988; Ruiz Luna and Berlanga-Robles 2003). The environmental elements such as climate, topography, soil, rainfall and vegetation etc. have influenced the patterns of land usage.

Objectives: The present study aims to fulfil the following objectives.

i. To analyse the trend of Land use Land cover (LULC) change in spatial and temporal framework.

ii. To study the factors responsible for changes in the LULC in the Kakching District.

Study Area:

Kakching District is situated in the state of Manipur which lies in the Eastern periphery of the Himalayan region, and in the North-Eastern part of the Indian sub-continent. The study area is situated between 24°13'19.092" to 24°33'36.125" North latitudes and 94°5'37.553" to 93°48'5.899" East longitudes with a total geographical area of 28,388 Hectares. The Kakching District came into existence when all its administrative units of the erstwhile Kakching Sub-division were transferred to form a new district on 8 December, 2016, a newly form district by the government of Manipur from the Thoubal District.

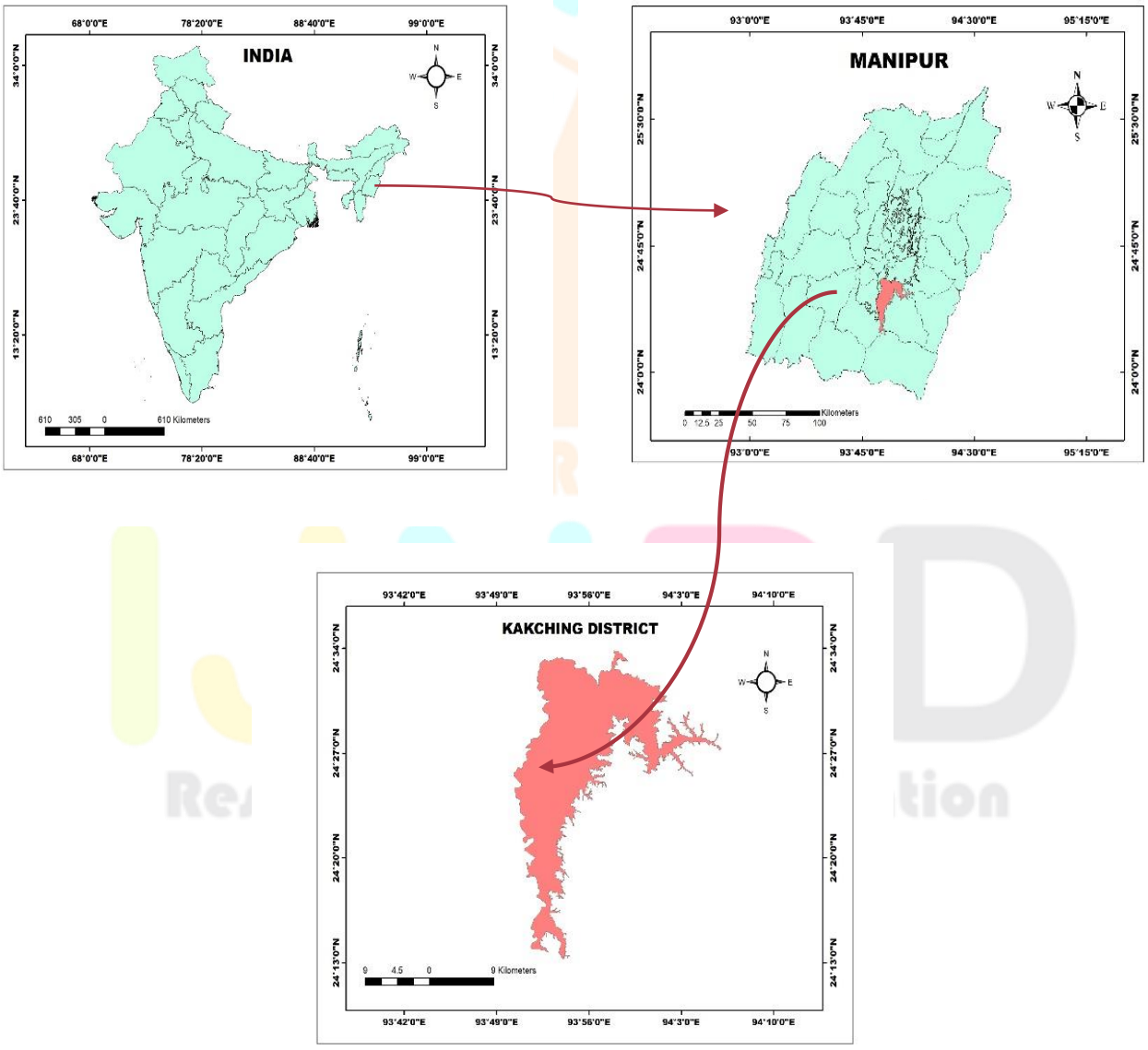

Figure 1: Location of study area -Kakching District.

Data Sources and Methodology:

The digital data images of IRS LISS-III and LISS-IV have been used to prepare the land-use map of the study area, which is obtained from the Indian Institute of Remote Sensing (IIRS), Dehradun, under the Indian Space Research organisation (ISRO). Geographic Information System (GIS) and Image Processing have been used for analysis and mapping of the land use/cover and other techniques used in the study as shown in the following flowchart in Figure 2.

Table 1. Characteristics of Satellite data used in the study:

Satellite	Sensor	Year of acquisition	No. of spectral bands	Range of spectral wavelength (μm)	Spatial resolution (m)	source
IRS	LISS-III	20/05/2014	4	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	23.5	IIRS (ISRO)
IRS	LISS-IV	16/05/2019	4	0.52-0.59 0.62-0.68 0.77-0.86 1.55-1.70	5.8	

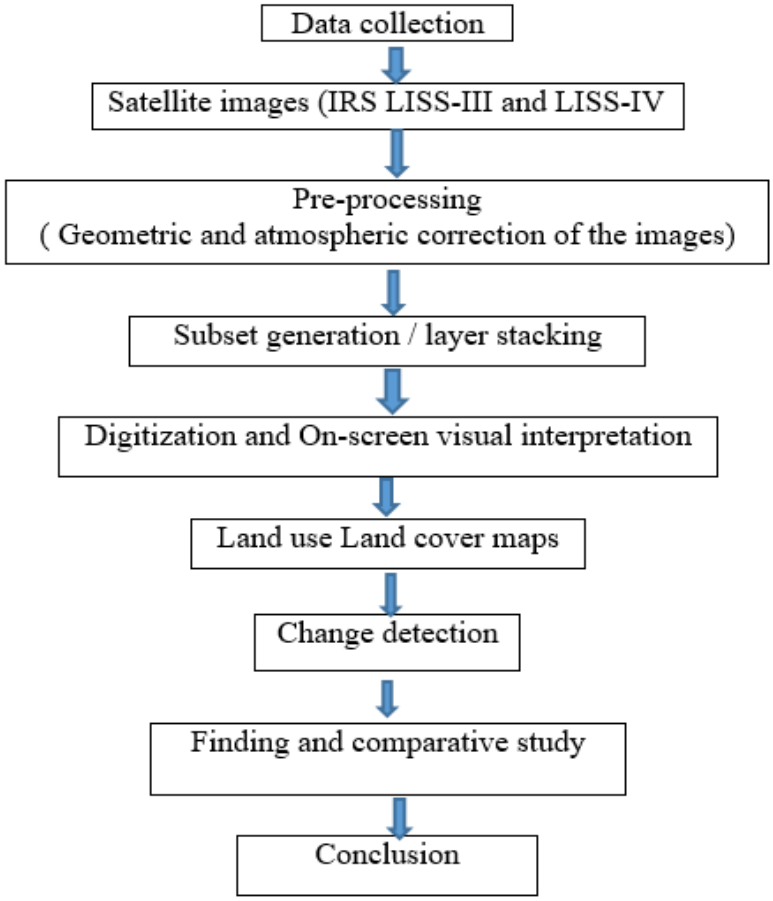

Figure 2: Methodology of research adopted for analysing the LULC.

Results and Discussion:

The delineated classes which are used in the current study of land use and land cover (LULC) are Aquaculture, Settlement/Built-up, Cropping-land, Wasteland, Wetland, River/ Water Body. The final results are prepared and presented in the form of maps, mathematical and statistical tables.

Table 2: Land Use/Cover classification of area between 2014 and 2019.

LULC Types	2014 Area in hectare	2019 Area in hectare	2014 to 2019 Change in hectare	2014 to 2019 Change in %	Remark
Aquaculture	4531	4450	-81	1.78	Area decreased
Settlement (old+ Add settlement)	2430	2655	+225	9.25	Area increased
Cropping land	15246	14945	-301	1.97	Area decreased
Open forest	746	1953	+1207	161.79	Area increased
Wasteland	1352	232	-1120	82	Area decreased
Wetland -area	3786	3841	+55	1.45	Area increased
Water body/ River	297	312	+15	5.05	Area increased
Total=	28,388	28,388			

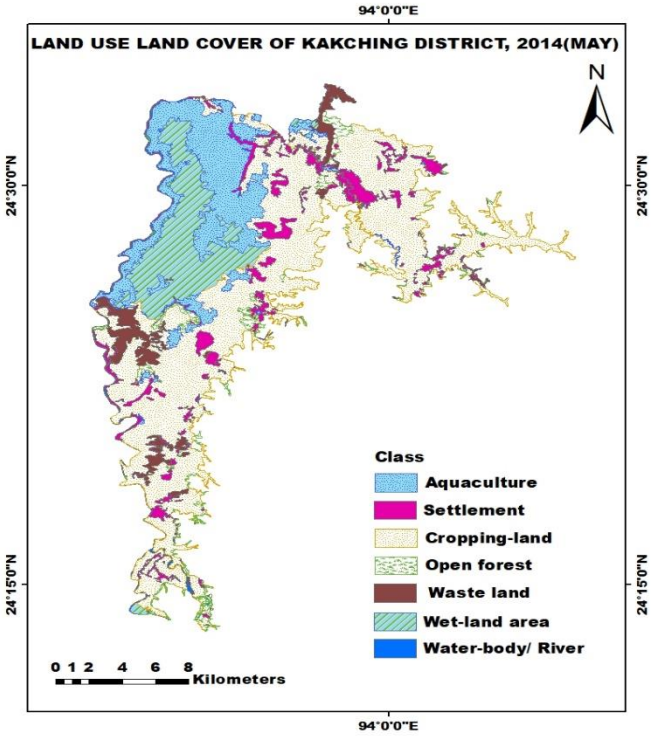

Figure 3. LULC classification map of 2014

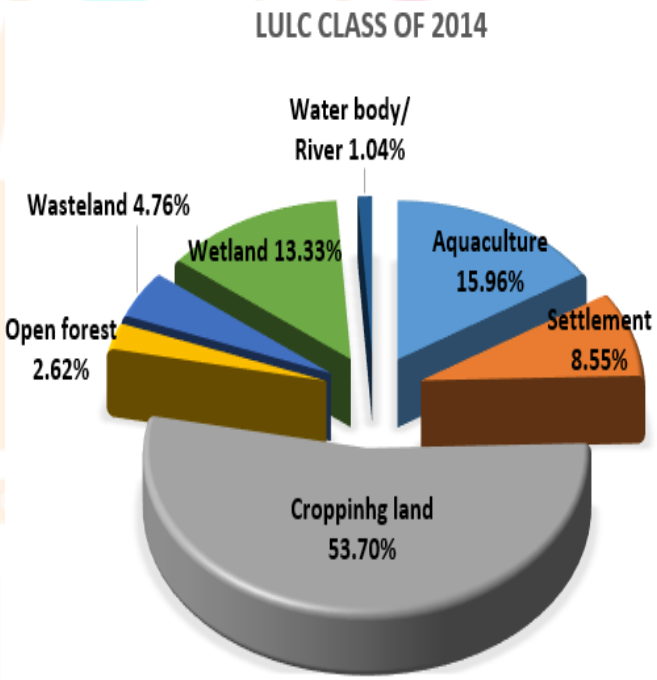

Figure 4. Graphical representation of the LULC in 2014

In the Table 2, the area wise classification of the Land use land cover (LULC) in 2014 of the total geographical area of 28,388 hectares are given Maximum land covered by cropping land is 53.70 % with an area of 15,246 hectares. The minimum area covered by waterbody/river is 1.04% and open forest of 2.62 % with the area of 294 hectares and 746 hectares respectively.

The wasteland and Settlement land are 4.76 % and 8.5 % with the area coverage of 1,352 hectares and 2,430 hectares respectively. Wetland and Aquaculture are 13.33 % and 15.96 % with the area coverage of 3,786 hectares and 4,531 hectares respectively. The area of coverage by the different class types are shown in the Figure- 3 and Figure- 4 also.

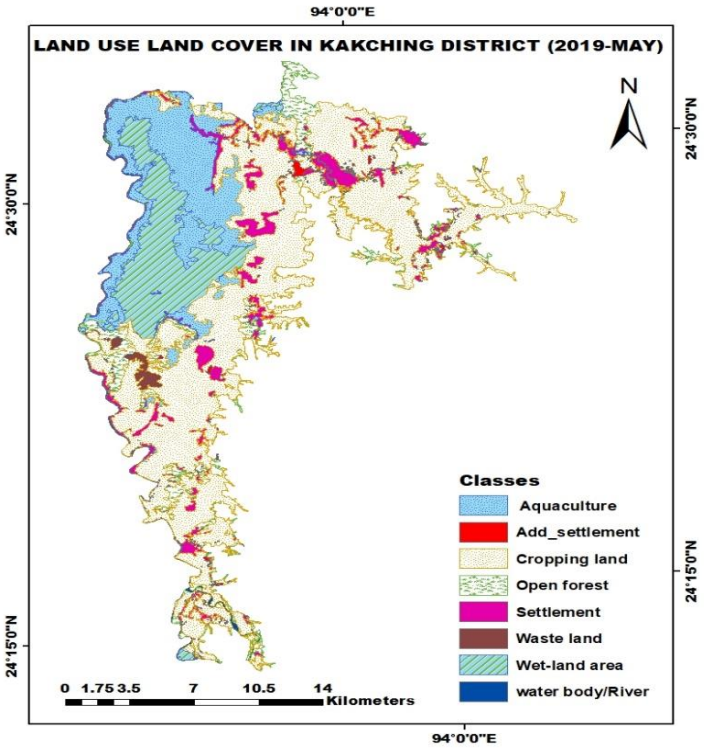

Figure 5. LULC classification map of 2019.

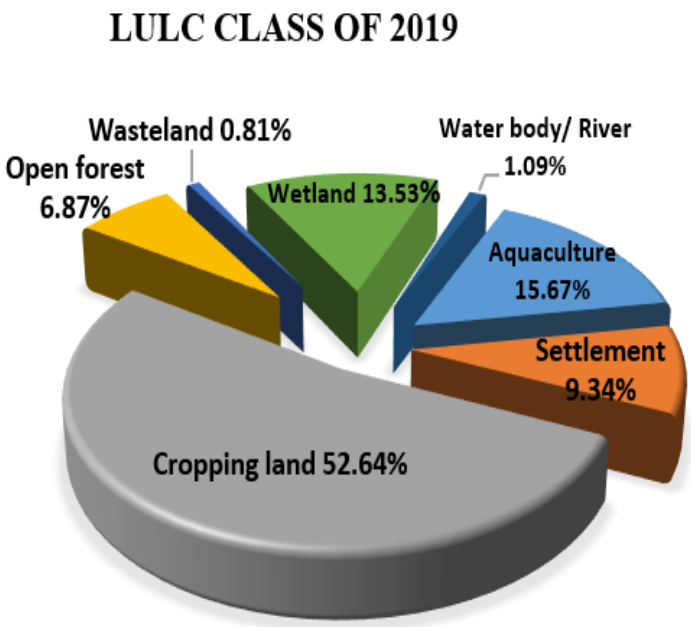

Figure 6. Graphical representation of the LULC in 2019.

In the Table -2, the class wise area occupancy of Land use/ Cover in 2019 is shown. The LULC map in the Figure-5 has shown different patterns of the land use/cover of the district by assigning different signatures distinctly. The maximum area is covered by Cropping land of 52.64 % with an area of 14945 hectares, which is the reduction of about 301 hectares.

In the statistical data of Figure-6, the minimum land used is occupied by wasteland of 0.81 % and Water body/ River of 1.09 % with an area of coverage 232 hectares and 312 hectares respectively. The Open forest covers 6.87 % with an area of 1953 hectares. The Settlement/Built up covers an increasing of about 0.79 % with an area of about 227 hectares. The Wetland and Aquaculture cover of 13.53 % and 15.67 % with the area of 3841 hectares and 4450 hectares respectively of the total geographical area of the Kakching District.

Conclusion:

The study of changes in land-use is very important and the land- use of a region is characterized by the spatial variation and influenced greatly by physio-socio-economic factors. The integration of GIS and Remote Sensing have been used to obtain and derive accurate information on the spatial changes in land use/cover over large areas and hence it has the capability to analyse a large amount of data within no time. From the above discussion it is apparent that the problem of reducing in the cropping land, aquaculture and wasteland areas are not beneficial for mankind and natural environment. The settlement/ built up areas are increasing as proportions of the open forest, wasteland and aquaculture land areas are being used for the construction of local industries such as brick farms, numerous educational institutes and residential due to ever increasing population and demand for more economic activities. The open forest land area are found to be increasing very much and it needs a proper planning, management and monitoring to utilise the resources which are beneficial to the people as well as to the environment in an effective ways. Therefore, the local authorities, govt. agencies, department etc. need to implement effective strategy and intensive care to protect the environment as well as to raise the standard of living of the people without degrading its biodiversity. GIS and Remote Sensing provides quick

and cheaper method of acquiring spatial information and data required for optimal land use planning in the years to come.

References:

1. Anderson, James R, Hardy, Ernest E, Roach and John T. 1972. A land-use classification system for use with remote-sensor data: U.S. Geol. Survey Cir. 671.

2. Anderson, J. R, Hardy, E. E, Roach, J. T. and Witmer R.E. 1976. A land use and land cover classification system for use with remote sensor data. USGS Professional Paper. U.S. Geological Survey. 964.

3. Arvind C. Pandy and M. S. Nathawat. 2006. Land Use Land Cover Mapping Through Digital Image Processing of Satellite Data – A case study from Panchkula, Ambala and Yamunanagar Districts, Haryana State, India.

4. Bhagawatrimal. 2011. Application of remote sensing and GIS on land use/land cover change in Kathmandu metropolitan city, Nepal. Journal of Theoretical and applied information Technology. 23(2): 80.

5. Bhaduri B, Harbor J, Engel B. and Grove M. 2000. Assessing watershed-scale, long-term hydrologic impacts of land-use change using a GIS-NPS model. Environmental Management. 26(6): 643-658.

6. Dwivedi R.S, Sreenivas K and Ramana K.V. 2005. Land-use/land-cover change analysis in part of Ethiopia using Landsat Thematic Mapper data. International Journal of Remote Sensing. 26(7): 1285-1287.

7. Irfan M, Negi V and Vatsal A. 2023. Land Change in Tirthan Valley: The Case of Great Himalayan National Park Conservation Area. Journal of Human Ecology. 83(1-3):1-16

8. Jaiswal RK, Saxena R and Mukherjee S. 1999. Application of Remote Sensing Technology for Land use / Land cover change analysis. J. Indian Soc. Remote Sensing. 27(2): 123-128.

9. Minakshi, R Chaursia and P K Sharma.1999. Land use / Land cover Mapping and Change Detection Using Satellite Data – A Case Study of Dehlon Block, District Ludhiana, Punjab. Journal of Indian Society and Remote Sensing. 27(2): 115-121.

10. Negi V and Irfan M. 2022. Land use/cover mapping and change detection using remote sensing techniques: A case of Upper Kullu Valley, Himachal Pradesh. Current World Environment, 17(2): 417-426.

11. Negi V, Chandel VBS and Brar K. 2022. Landscape change analysis of Upper Beas Valley, India using Corona and PlanetScope Imageries. Punjab Geographers. 18: 8- 30.

12. Prakasam C. 2010. Land use and land cover change detection through Remote Sensing approach: A case study of Kodaikanal taluk, Tamilnadu. Department of Geography. The University of Burdwan. International Journal of Geomatics and Geosciences. 1(2): 150-158

13. Pengfeng Xiao. 2006. A Land Use/ Cover Classification System Based on Medium Resolution Remote Sensing Data [J]. China Land Science. 20(2): 33-38.

14. Raman R and Punia M. 2012. Land use dynamics and landscape fragmentation in Higher Garhwal Himalaya, India. Asian Journal of Geoinformatics, 12(1): 1-12.

15. R.Manonmani and G.Mary Divya Suganya. (2010). Remote Sensing and GIS Application In Change Detection Study In Urban Zone Using Multi Temporal Satellite, Institute of Remote Sensing. International Journal of Geomatics and Geosciences, 1(1). 60-65

16. R. Sakthivel, M. Manivel, N. Jawahar raj, V. Pugalanthi, N. Ravichandran and Vijay D. Anand. 2010. Remote sensing and GIS based forest cover change detection study in Kalrayan hills, Tamil Nadu. Journal of Environmental Biology. 737-747.

17. S. Kilica, F. Evrendilekb, S. Berberogluc and A. C. Demirkesend. 2006. Environmental monitoring of land use and land cove changes in Amik plain, turkey. 114(3): 157- 168.

18. Singh Gurdeep , Singh, P. K, Dasgupta and Rajarshi. (2009). Developing Potential Land Use/Land Cover Area In The Talcher-Angul Region For Suitable Location of Future Industries through Remote Sensing & GIS. 123-134.

19. Vishwa CB, Kaur BK and Simrit K 2013. Land use/cover change and its implications for Kullu district of Himachal Pradesh, India. International Journal of Geomatics and Geoscience, 3(3): 538-551.

20. Xiaomei Y and Ronqing L.Q.Y. (1999). Change Detection Based on Remote Sensing Information Model and its Application to Coastal Line of Yellow River Delta – Earth Observation Center, NASDA, China.